

CLAIMS

1. A pharmaceutical composition for alleviating tissue hypoxia, comprising
  - (1)  $\alpha$ -globin having the Titusville mutation,
  - (2) a polynucleotide comprising a base sequence encoding an amino acid sequence of said  $\alpha$ -globin having the Titusville mutation, or
  - (3) an expression vector comprising said polynucleotide, and a pharmaceutically acceptable carrier or diluent.
2. A method for alleviating tissue hypoxia, comprising administering to a subject in need thereof
  - (1)  $\alpha$ -globin having the Titusville mutation,
  - (2) a polynucleotide comprising a base sequence encoding an amino acid sequence of said  $\alpha$ -globin having the Titusville mutation, or
  - (3) an expression vector comprising said polynucleotide, in an amount effective therefor.
3. A method for treating or preventing ischemic conditions, comprising administering to a subject in need thereof
  - (1)  $\alpha$ -globin having the Titusville mutation,
  - (2) a polynucleotide comprising a base sequence encoding an amino acid sequence of said  $\alpha$ -globin having the Titusville mutation, or
  - (3) an expression vector comprising said polynucleotide, in an amount effective therefor.
4. The method according to claim 3, wherein the ischemic conditions are respiratory failure, ischemic diseases, ischemic heart diseases, myocardial infarction, angina, cerebral ischemia, obstructive arterial disorders, or obstructive arteriosclerosis.
5. A method for enhancing an oxygen metabolism in tissues, comprising administering to a subject in need thereof
  - (1)  $\alpha$ -globin having the Titusville mutation,
  - (2) a polynucleotide comprising a base sequence encoding an amino acid sequence of said  $\alpha$ -globin having the Titusville

mutation, or

(3) an expression vector comprising said polynucleotide, in an amount effective therefor.

6. The method according to claim 5, wherein the oxygen metabolism is an oxidative enzymatic activity.

7. A method for modificating of a tissue, comprising administering to a subject in need thereof

(1)  $\alpha$ -globin having the Titusville mutation,

(2) a polynucleotide comprising a base sequence encoding an amino acid sequence of said  $\alpha$ -globin having the Titusville mutation, or

(3) an expression vector comprising said polynucleotide, in an amount effective therefor.

8. The method according to claim 7, wherein the tissue is muscles, heart, nerves, or skin.

9. A method for enhancing exercise capacity, comprising administering to a subject in need thereof

(1)  $\alpha$ -globin having the Titusville mutation,

(2) a polynucleotide comprising a base sequence encoding an amino acid sequence of said  $\alpha$ -globin having the Titusville mutation, or

(3) an expression vector comprising said polynucleotide, in an amount effective therefor.

10. The method according to claim 9, wherein the exercise capacity is running capacity.

11. A method for treating or preventing cerebrovascular dementia, comprising administering to a subject in need thereof

(1)  $\alpha$ -globin having the Titusville mutation,

(2) a polynucleotide comprising a base sequence encoding an amino acid sequence of said  $\alpha$ -globin having the Titusville mutation, or

(3) an expression vector comprising said polynucleotide, in an amount effective therefor.

12. An artificial blood comprising  $\alpha$ -globin having the Titusville mutation.

13. A transgenic non-human animal having expressably a polynucleotide comprising a base sequence encoding an amino acid sequence of  $\alpha$ -globin having the Titusville mutation.